AMENDMENTS TO THE CLAIMS

The claims in this listing will replace all prior versions, and listings, of claims in the application.

1. (Original) An optical element retracting mechanism for a retractable lens including an optical system having a plurality of optical elements, said optical element retracting mechanism comprising:

a linearly movable ring configured to be guided along an optical axis of said optical system without rotating, said linearly movable ring retracting toward a plane along said optical axis when said retractable lens moves from an operational state to a fully-retracted state;

a swingable holder mounted on a pivot and pivotable about said pivot, and further positioned inside and supported by said linearly movable ring, said swingable holder supporting a retractable optical element as one of said plurality of optical elements;

a position-controller configured to hold said swingable holder such that said retractable optical element remains on said optical axis when said retractable lens is in said operational state, said position-controller further configured to rotate said swingable holder about said pivot such that said retractable optical element retracts to a position which deviates from said optical axis when said linearly movable ring, together with said swingable holder, retracts toward said plane;

at least one support plate supporting said pivot, and including a first elongated hole and a second elongated hole, a direction of elongation of said first elongated hole and a direction of elongation of said second elongated hole

being generally orthogonal to each other;

a support plate fixing device fixing said at least one support plate to said linearly movable ring, wherein said support plate fixing device is configured to allow said at least one support plate to move relative to said linearly movable ring in directions lying in a plane generally orthogonal to said optical axis when said support plate fixing device is in a released state;

a first rotatable shaft having a first axis substantially parallel to said optical axis, supported by said linearly movable ring to be rotatable about said first axis, and having at least one first eccentric pin which is engaged in said first elongated hole to be movable therein in said direction of elongation of said first elongated hole, said at least one first eccentric pin having an axis eccentric to said first axis, wherein when said first rotatable shaft is rotated, a first movement force is applied on said at least one support plate in a direction generally orthogonal to said direction of elongation of said first elongated hole;

a second rotatable shaft having a second axis substantially parallel to said optical axis, supported by said linearly movable ring to be rotatable about said second axis, and having at least one second eccentric pin which is engaged in said second elongated hole to be movable therein in said direction of elongation of said second elongated hole, said at least one second eccentric pin having an axis eccentric to said second axis, wherein when said second rotatable shaft is rotated, a second movement force is applied on said at least one support plate in a direction generally orthogonal to said direction of elongation of said second elongated hole; and

a movement direction setting device, provided on said support plate and

said linearly movable ring, and setting the direction of movement of said at least one support plate in a plane substantially orthogonal to said optical axis when said at least one of said first and second movement force is applied on said at least one support plate by at least one of said rotation of said first rotatable shaft and said rotation of said second rotatable shaft when said support plate fixing device is in said released state.

2. (Original) The optical element retracting mechanism according to claim 1, wherein said movement direction setting device comprises:

a third elongated hole formed on said at least one support plate so that a direction of elongation of said third elongated hole is substantially parallel to one of said direction of elongation of said first elongated hole and said direction of elongation of said second elongated hole; and

a projection projecting from said linearly movable ring and engaged in said third elongated hole to be movable therein,

wherein a rotation of one of said first rotatable shaft and said second rotatable shaft causes said at least one support plate to move linearly along a direction of elongation of one of said first elongated hole and said second elongated hole with which the other of said first rotatable shaft and said second rotatable shaft is engaged, and

wherein a rotation of said other of said first rotatable shaft and said second rotatable shaft causes said at least one support plate to move non-linearly along a direction substantially orthogonal to said direction of elongation of said one of said first elongated hole and said second elongated hole.

3. (Original) The optical element retracting mechanism according to claim 2, wherein two of said first, second and third elongated holes, said directions of elongation thereof being substantially parallel to each other, are formed at different positions in both a lengthwise direction of each of said two elongated holes and a widthwise direction of each of said two elongated holes, and wherein a space between said two elongated holes in said lengthwise direction is greater than a space between said two elongated holes in said widthwise direction.

4. (Original) The optical element retracting mechanism according to claim 3, wherein a remaining one of said first elongated hole, said second elongated hole and said third elongated hole is positioned between said two elongated holes in said lengthwise direction, and is proximately positioned to one of said two elongated holes.

5. (Original) The optical element retracting mechanism according to claim 2, wherein said pivot shaft is positioned between two of said first, second and third elongated holes said directions of elongation of which are substantially parallel to each other in a lengthwise direction of each of said two elongated holes.

6. (Original) The optical element retracting mechanism according to claim 1, wherein said movement direction setting device comprises:

a third elongated hole formed on said at least one support plate so that a direction of elongation of said third elongated hole is inclined to both said direction of elongation of said first elongated hole and said direction of elongation of said second elongated hole; and

a projection projecting from said linearly movable ring to be engaged in said third elongated hole to be movable therein,

wherein a rotation of one of said first rotatable shaft and said second rotatable shaft causes said support plate to move non-linearly along a direction including a component of said direction of elongation of said second elongated hole, in which said second eccentric pin of said second rotatable shaft is engaged, and

wherein a rotation of the other of said first rotatable shaft and said second rotatable shaft causes said support plate to move non-linearly along a direction including a component of said direction of elongation of said first elongated hole, in which said first eccentric pin of said first rotatable shaft is engaged.

7. (Original) The optical element retracting mechanism according to claim 1,

wherein said at least one support plate comprises a pair of support plates fixed to front and rear surfaces of said linearly movable ring in said optical axis direction and supports opposite ends of said pivot, respectively;

wherein a pair of said first elongated holes and a pair of said second elongated holes are formed on said pair of support plates, respectively, such that said pair of first elongated holes face each other in said optical axis direction and extend generally parallel to each other, and such that said pair of second elongated holes face each other in said optical axis direction and extend parallel to each other, a direction of elongation of said pair of first elongated holes being generally orthogonal to a direction of elongation of said pair of second elongated holes;

wherein said first rotatable shaft includes a pair of said first eccentric pins at opposite ends thereof, each of said pair of first eccentric pins having an axis eccentric to said first axis, said pair of first eccentric pins respectively engaged in said pair of first elongated holes; and

wherein said second rotatable shaft includes a pair of said second eccentric pins at opposite ends thereof, each of said pair of second eccentric pins having an axis eccentric to said second axis, said pair of second eccentric pins respectively engaged in said pair of second elongated holes.

8. (Original) The optical element retracting mechanism according to claim 7, wherein said pair of first eccentric pins have a common axis eccentric to said first axis of said first rotatable shaft;

wherein said pair of second eccentric pins have a common axis eccentric to said second axis of said second rotatable shaft; and

wherein said pair of support plates are movable relative to said linearly movable ring without changing a relative position between said pair of support plates, by rotating at least one of said first rotatable shaft and second rotatable shaft, when said support plate fixing device is in said released state.

9. (Original) The optical element retracting mechanism according to claim 7, wherein said movement direction setting device comprises:

a pair of third elongated holes formed on said pair of support plates, respectively; and

a pair of front and rear projections projecting from front and rear of said linearly movable ring to be engaged in said pair of third elongated holes to be movable therein, respectively.

10. (Original) The optical element retracting mechanism according to claim 9, wherein said linearly movable ring comprises a pair of generally parallel flat surfaces which are separate from each other in said optical axis direction, and which extend in a direction generally orthogonal to said optical axis, said pair of support plates being pressed against said pair of parallel flat surfaces and are fixed thereto by said support plate fixing device, respectively.

11. (Original) The optical element retracting mechanism according to claim 7, further comprising an internal optical element positioned inside said linearly movable ring on one of opposite sides of said retractable optical element in said optical axis direction, wherein said pair of support plates are attached to said opposite ends of said linearly movable ring and positioned on opposite sides of said internal optical element in said optical axis direction, respectively.

12. (Original) The optical element retracting mechanism according to claim 11, wherein said internal optical element comprises at least one of a shutter and a diaphragm.

13. (Original) The optical element retracting mechanism according to claim 7, wherein said support plate fixing device comprises:

a screw hole on one of said pair of support plates and penetrating therethrough in said optical axis direction;

a screw insertion hole on the other of said pair of support plates and penetrating therethrough in said optical axis direction; and

a set screw in said screw insertion hole and screwed through said screw hole.

14. (Currently Amended) The optical element retracting mechanism

according to claim 1, wherein said swingable holder further comprises:

a cylindrical lens holder portion which holds said retractable optical element;

a pivoted cylindrical portion fitted on [[a]] said pivot and rotatable on said pivot; and

a swing arm portion extending between said cylindrical lens holder and said pivoted cylindrical portion to connect said cylindrical lens holder to said pivoted cylindrical portion.

15. (Original) The optical element retracting mechanism according to claim 1, said position-control device comprises:

a spring configured to bias said swingable holder to rotate in a direction to position said retractable optical element on said optical axis; and

a cam mechanism which rotates said swingable holder to said deviated position from said optical axis, against the biasing force of said spring, when said linearly movable ring, together with said swingable holder, retracts toward said plane.

16. (Original) The optical element retracting mechanism according to claim 1, wherein said plurality of optical elements comprise at least one rear optical element positioned behind said retractable optical element when said retractable lens is in said operational state; and

wherein said retractable optical element is positioned in an off-axis space radially outside an on-axis space in which said rear optical element is positioned, so that said retractable optical element and said rear optical element are in a same positional range in the optical axis direction, when said retractable lens is

in said fully-retracted state.

17. (Original) The optical element retracting mechanism according to claim 1, wherein said pivot extends generally parallel to said optical axis.

18. (Original) The optical element retracting mechanism according to claim 1, wherein said retractable optical element comprises a lens group.

19. (Original) The optical element retracting mechanism according to claim 1, wherein said optical system comprises a zoom photographing optical system; and

wherein said retractable optical element comprises a lens group as a part of said zoom photographing optical system.

20. (Original) The optical element retracting mechanism according to claim 1, wherein said optical element retracting mechanism is incorporated in a digital camera.

21. (Original) The optical element retracting mechanism according to claim 1, wherein each of said first elongated hole and said second elongated hole is formed as a through hole which penetrates through said at least one support plate;

wherein an end of said first eccentric pin includes a first operating portion via which said first eccentric pin can be rotated; and

wherein an end of said second eccentric pin includes a second operating portion via which said second eccentric pin can be rotated.

22. (Original) The optical element retracting mechanism according to claim 7, wherein at least one of said pair of first elongated holes and at least one of said pair of second elongated holes are formed as through holes which

penetrate said pair of support plates, respectively;

wherein an end of one of said pair of first eccentric pins engaged in said through hole includes a first operating portion via which said one of said pair of first eccentric pins can be rotated; and

wherein an end of one of said pair of second eccentric pins which is engaged in said through hole includes a second operating portion via which said one of said pair of second eccentric pins can be rotated.

23. (Original) The optical element retracting mechanism according to claim 21, wherein said first operating portion and second operating portion face a frontward direction in said optical axis direction, respectively,

wherein said optical element retracting mechanism further comprises:

an outer barrel which surrounds said linearly movable ring, and is provided with a radially inward flange in front of said linearly movable ring,

wherein said radially inward flange includes a first through hole which penetrates through said radially inward flange in said optical axis direction so that said first operating portion is accessible from front of said linearly movable ring through said first through hole, and

wherein said radially inward flange includes a second through hole which penetrates through said radially inward flange in said optical axis direction so that said second operating portion is accessible from said front of said linearly movable ring through said second through hole.

24. (Original) The optical element retracting mechanism according to claim 23, wherein said retractable lens comprises a lens barrier mechanism detachably attached to a front part of said radially inward flange to cover said

first through hole and said second through hole.

25. (Original) The optical element retracting mechanism according to claim 23, wherein said outer barrel supports one of said plurality of optical elements positioned in front of said retractable optical element, said outer barrel retracting toward said plane together with said linearly movable ring along said optical axis, when said retractable lens moves from said operational state to said fully-retracted state.

26. (Original) The optical element retracting mechanism according to claim 22, wherein said support plate fixing device comprises:

a screw hole formed on one of said pair of support plates to penetrate therethrough in said optical axis direction;

a screw insertion hole on the other of said pair of support plates and penetrating therethrough in said optical axis direction; and

a set screw in said screw insertion hole and screwed through at least one screw hole;

wherein one of opposite ends of said set screw which faces a side toward which said first operating portion and said second operation portion are directed includes a third operating portion via which said set screw can be rotated.

27. (Original) The optical element retracting mechanism according to claim 26, wherein said third operating portion of said set screw faces toward a frontward direction in the optical axis direction,

wherein said optical element retracting mechanism further comprises:

an outer barrel which surrounds said linearly movable ring, and is provided with a radially inward flange positioned in front of said linearly movable

ring,

wherein said radially inward flange includes at least one through hole which penetrates through said radially inward flange in said optical axis direction, said third operating portion of said set screw accessible from front of said linearly movable ring through said through hole.

28. (Original) The optical element retracting mechanism according to claim 26, wherein said retractable lens comprises a lens barrier mechanism detachably attached to a front part of said radially inward flange to cover said through hole.

29. (Original) The optical element retracting mechanism according to claim 24, wherein said outer barrel supports one of said plurality of optical elements positioned in front of said retractable optical element, said outer barrel retracting toward said plane together with said linearly movable ring along said optical axis when said retractable lens moves from said operational state to said fully-retracted state.

30. (Original) The optical element retracting mechanism according to claim 21, wherein each of said first operating portion and said second operating portion comprises a slot in which an adjusting tool can be engaged.

31. (Original) The optical element retracting mechanism according to claim 22, wherein each of said first operating portion and said second operating portion comprises a slot in which an adjusting tool can be engaged.

32. (Currently Amended) An optical element retracting mechanism for a retractable lens including an optical system having a plurality of optical elements, said optical element retracting mechanism comprising:

a linearly movable ring configured to be guided along an optical axis of said optical system without rotating, and which retracts toward a plane along said optical axis when said retractable lens moves from an operational state to a fully-retracted state;

a swingable holder on a pivot and swingable about said pivot, and further positioned inside said linearly movable ring to be supported thereby, said swingable holder supporting a retractable optical element as one of said plurality of optical elements;

a position-controller holding said swingable holder such that said retractable optical element remains on said optical axis when said retractable lens is in said operational state, and further rotating said swingable holder about said pivot such that said retractable optical element retracts to a position which deviates from said optical axis when said linearly movable ring, together with said swingable holder, retracts toward said plane;

a pair of support plates which are fixed to front and rear surfaces of said linearly movable ring in said optical axis direction to support opposite ends of said pivot, respectively, wherein a pair of first elongated holes and a pair of second elongated holes are located on said pair of support plates, respectively, such that said pair of first elongated holes face each other in said optical axis direction and extend generally parallel to each other, and such that said pair of second elongated holes face each other in said optical axis direction and extend generally parallel to each other, a direction of elongation of said pair of first elongated holes and a direction of elongation of said pair of second elongated holes being generally orthogonal to each other;

a support plate fixing device fixing said pair of support plates to said linearly movable ring, wherein said support plate fixing device allows said pair of support plates to move relative to said linearly movable ring in directions lying in a plane generally orthogonal to said optical axis when said support plate fixing device is in a released state;

a first rotatable shaft having a first axis generally parallel to said optical axis, supported by said linearly movable ring to be rotatable about said first axis, and having a pair of first eccentric pins at opposite ends of said first rotatable shaft, each of said pair of first eccentric pins having an axis eccentric to said first axis, said pair of first eccentric pins being respectively engaged in said pair of first elongated holes to be movable therein in said direction of elongation of said pair of first elongated holes, wherein when said first rotatable shaft is rotated, a first movement force is applied on said pair of support plates in a direction generally orthogonal to said direction of elongation of said first elongated hole;

a second rotatable shaft having a second axis generally parallel to said optical axis, supported by said linearly movable ring to be rotatable about said second axis, and having a pair of second eccentric pins at opposite ends of said second rotatable shaft, each of said pair of second eccentric pins having an axis eccentric to said second axis, said pair of second eccentric pins being respectively engaged in said pair of second elongated holes of said pair of support plates to be movable therein in said direction of elongation of said pair of second elongated holes, wherein when said second rotatable shaft is rotated, a second movement force is applied on said pair of support plates in a direction generally orthogonal to said direction of elongation of said second elongated

hole; and

a movement direction setting device, provided on said pair of support plates and said linearly movable ring and setting the direction of movement of said pair of support plates in a plane generally orthogonal to said optical axis when at least [[on]] one of said first and second movement force is applied on said pair of support plates by a respective at least one of said rotation of said first rotatable shaft and said rotation of said second rotatable shaft when said support plate fixing device is in said released state.

33. (Previously Presented) A digital camera having a body and a lens barrel, the lens barrel housed within the body, the lens barrel comprising a retractable lens including an optical system having a plurality of optical elements, the lens barrel further comprising a retracting mechanism, the retracting mechanism comprising:

a linearly movable ring configured to be guided along an optical axis of said optical system, said linearly movable ring retracting toward a plane along said optical axis when said retractable lens moves from an operational state to a retracted state;

a swingable holder mounted on a pivot and pivotable about said pivot, and further substantially positioned inside and supported by said linearly movable ring, said swingable holder supporting a retractable optical element as one of said plurality of optical elements;

a position-controller configured to hold said swingable holder such that said retractable optical element remains on said optical axis when said retractable lens is in said operational state, said position-controller further

configured to rotate said swingable holder about said pivot such that said retractable optical element retracts to a position which deviates from said optical axis when said linearly movable ring, together with said swingable holder, retracts toward said plane;

at least one support plate supporting said pivot, and including a first elongated hole and a second elongated hole, a direction of elongation of said first elongated hole and a direction of elongation of said second elongated hole being generally orthogonal to each other;

a support plate fixing device fixing said at least one support plate to said linearly movable ring, wherein said support plate fixing device is configured to allow said at least one support plate to move relative to said linearly movable ring in directions lying in a plane generally orthogonal to said optical axis when said support plate fixing device is in a released state;

a first rotatable shaft having a first axis substantially parallel to said optical axis, supported by said linearly movable ring to be rotatable about said first axis, and having at least one first eccentric pin which is engaged in said first elongated hole to be movable therein in said direction of elongation of said first elongated hole, said at least one first eccentric pin having an axis eccentric to said first axis, wherein when said first rotatable shaft is rotated, a first movement force is applied on said at least one support plate in a direction generally orthogonal to said direction of elongation of said first elongated hole;

a second rotatable shaft having a second axis substantially parallel to said optical axis, supported by said linearly movable ring to be rotatable about said second axis, and having at least one second eccentric pin which is engaged in

said second elongated hole to be movable therein in said direction of elongation of said second elongated hole, said at least one second eccentric pin having an axis eccentric to said second axis, wherein when said second rotatable shaft is rotated, a second movement force is applied on said at least one support plate in a direction generally orthogonal to said direction of elongation of said second elongated hole; and

a movement direction setting device, provided on said support plate and said linearly movable ring, and setting the direction of movement of said at least one support plate in a plane substantially orthogonal to said optical axis when said at least one of said first and second movement force is applied on said at least one support plate by at least one of said rotation of said first rotatable shaft and said rotation of said second rotatable shaft when said support plate fixing device is in said released state.

34. (Previously Presented) The camera according to claim 33, wherein said movement direction setting device comprises:

a third elongated hole formed on said at least one support plate so that a direction of elongation of said third elongated hole is substantially parallel to one of said direction of elongation of said first elongated hole and said direction of elongation of said second elongated hole; and

a projection projecting from said linearly movable ring and engaged in said third elongated hole to be movable therein,

wherein a rotation of one of said first rotatable shaft and said second rotatable shaft causes said at least one support plate to move linearly along a direction of elongation of one of said first elongated hole and said second

elongated hole with which the other of said first rotatable shaft and said second rotatable shaft is engaged, and

wherein a rotation of said other of said first rotatable shaft and said second rotatable shaft causes said at least one support plate to move non-linearly along a direction substantially orthogonal to said direction of elongation of said one of said first elongated hole and said second elongated hole.

35. (Previously Presented) The camera according to claim 33, wherein said movement direction setting device comprises:

a third elongated hole formed on said at least one support plate so that a direction of elongation of said third elongated hole is inclined to both said direction of elongation of said first elongated hole and said direction of elongation of said second elongated hole; and

a projection projecting from said linearly movable ring to be engaged in said third elongated hole to be movable therein,

wherein a rotation of one of said first rotatable shaft and said second rotatable shaft causes said support plate to move non-linearly along a direction including a component of said direction of elongation of said second elongated hole, in which said second eccentric pin of said second rotatable shaft is engaged, and

wherein a rotation of the other of said first rotatable shaft and said second rotatable shaft causes said support plate to move non-linearly along a direction including a component of said direction of elongation of said first elongated hole, in which said first eccentric pin of said first rotatable shaft is engaged.

36. (Previously Presented) The camera according to claim 33,

wherein said at least one support plate comprises a pair of support plates fixed to front and rear surfaces of said linearly movable ring in said optical axis direction and supports opposite ends of said pivot, respectively;

wherein a pair of said first elongated holes and a pair of said second elongated holes are formed on said pair of support plates, respectively, such that said pair of first elongated holes face each other in said optical axis direction and extend generally parallel to each other, and such that said pair of second elongated holes face each other in said optical axis direction and extend parallel to each other, a direction of elongation of said pair of first elongated holes being generally orthogonal to a direction of elongation of said pair of second elongated holes;

wherein said first rotatable shaft includes a pair of said first eccentric pins at opposite ends thereof, each of said pair of first eccentric pins having an axis eccentric to said first axis, said pair of first eccentric pins respectively engaged in said pair of first elongated holes; and

wherein said second rotatable shaft includes a pair of said second eccentric pins at opposite ends thereof, each of said pair of second eccentric pins having an axis eccentric to said second axis, said pair of second eccentric pins respectively engaged in said pair of second elongated holes.

37. (Currently Amended) The camera according to claim 33, wherein said swingable holder further comprises:

a cylindrical lens holder portion which holds said retractable optical element;

a pivoted cylindrical portion fitted on [[a]] said pivot and rotatable on said pivot; and

a swing arm portion extending between said cylindrical lens holder and said pivoted cylindrical portion to connect said cylindrical lens holder to said pivoted cylindrical portion.

38. (Previously Presented) The camera according to claim 33, said position-control device comprises:

a spring configured to bias said swingable holder to rotate in a direction to position said retractable optical element on said optical axis; and

a cam mechanism which rotates said swingable holder to said deviated position from said optical axis, against the biasing force of said spring, when said linearly movable ring, together with said swingable holder, retracts toward said plane.

39. (Previously Presented) The camera according to claim 33, wherein said plurality of optical elements comprise at least one rear optical element positioned behind said retractable optical element when said retractable lens is in said operational state; and

wherein said retractable optical element is positioned in an off-axis space radially outside an on-axis space in which said rear optical element is positioned, so that said retractable optical element and said rear optical element are in a same positional range in the optical axis direction, when said retractable lens is in said retracted state.

40. (Previously Presented) The camera according to claim 33, wherein said pivot extends generally parallel to said optical axis.

41. (Previously Presented) The camera according to claim 33, wherein said retractable optical element comprises a lens group.

42. (Previously Presented) The camera according to claim 33, wherein said optical system comprises a zoom photographing optical system; and

wherein said retractable optical element comprises a lens group as a part of said zoom photographing optical system.

43. (Previously Presented) The camera according to claim 33, wherein each of said first elongated hole and said second elongated hole is formed as a through hole which penetrates through said at least one support plate;

wherein an end of said first eccentric pin includes a first operating portion via which said first eccentric pin can be rotated; and

wherein an end of said second eccentric pin includes a second operating portion via which said second eccentric pin can be rotated.